higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

RENEWABLE ENERGY TECHNOLOGIES
NQF LEVEL 3

16 November 2022

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 South Africa's economy is energy-intensive and overly reliant on coal for electrical energy generation. (2)

1.2
- Job creation and access to hot water (socio-economic)
- Reduction of electrical energy demand (job creation and load reduction)
- Industrialisation (job creation and increased local manufacturing capacity) (3)

1.3
- Reduction in residential power usage and peak-hour demand will reduce costs and can improve electrical grid security.
- Reduced municipal CO_2 emissions. (2)

1.4
- SWH systems use free of charge radiation (sunlight) to heat water.
- Solar thermal systems are non-electrical and can reduce the use of electrical energy.
- Using SWH technologies as an alternative to an electric geyser can help reduce GHG emissions associated with fossil fuel usage.
- SWH systems will reduce peak-load demand. (4)

1.5
- System lifespan
- System efficiency
- Behavioural patterns (usage of hot water)
- Municipal tariffs (Eskom)
- Subsidies (Any 4 × 1) (4)

1.6
- The Water Services Act recognises that water is a natural resource that belongs to all people.
- The Act regulates a person's right to use water, and it gives details about the fair distribution and responsible use of water resources.
- Distributed water must be clean for general consumption, drinking and sanitation purposes.
- The Act regulates water services to households, commercial properties, and industry, and sets the standards for municipalities as well as for determining water tariffs.
- The Act establishes the duties and rights of the government and water service providers, and it promotes proper water management by all concerned. (Any 2 × 1) (2)

1.7
- 50% of hot water must be provided by means other than electricity, e.g., solar thermal heating. All exposed pipes to and from the hot water cylinders and central heating system must be insulated with pipe insulation material (SANS 204, energy efficiency in buildings).
- Domestic SWH systems should perform in accordance with SANS 1307.
- The installation, maintenance, repair, and replacement of domestic SWH systems should be done in accordance with SANS 10106.
- The installation in buildings shall be in accordance with SANS 10254 and SANS 10252-1. (Any 3 × 1) (3)

[20]

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QUESTION 2

2.1
2.1.1 False
2.1.2 True
2.1.3 False
2.1.4 True
2.1.5 False
2.1.6 True
2.1.7 True

(7 × 1) (7)

2.2 2.2.1 No (1)

2.2.2 Mr Blue must first repair any damage on roof. The system must never be installed on a damaged roof. The roof envelope (tiles) must be structurally sound to carry the weight of the system. (2)

2.2.3 Remove the source of shading. Prune or remove the tree. Move collector higher up on the roof or to another part of the roof that is not shaded. Add an additional collector to compensate for the effect of shading. (3)

2.2.4
- The system must be placed in such a way that the tank spans two main trusses; trusses to be braced to support installation.
- Rafters to be strengthened; spread additional load to load-bearing points.
- Add thicker timbers alongside the rafters.
- Add cross-bracing rafters.
- Add additional supporting struts to the truss. (Any 4 × 1) (4)

2.3 $\Delta = V \times Ce \times \Delta T$✓
$= 100 \times 0{,}0007 \times 90$✓
$= 6{,}3$ litres✓ (3)

2.4 2.4.1 (a) Conduction: Occurs when two objects or substances at different temperatures are in (direct) contact with each other. Heat flows from the high-temperature object to the lower temperature one, until both are at the same temperature.✓✓

(b) Convection: Occurs when warmer areas of a liquid or gas rise to the top of cooler areas in a liquid or gas.✓✓

(c) Radiation: Is energy emitted in the form of light.✓✓ (Any 2 × 2) (4)

2.4.2 For heat transfer to occur, there must be a *temperature difference* between the two materials.✓ (1)

2.5 1. Irradiation = 1kW/m^2 × 8h = 8 kWh/m^2✓
2. Required energy amount = 5,75 kWh/day ÷ 0,4 = 14,375 kWh✓
3. Required collector area (m^2) = 14,374 kWh✓ ÷ 8 kWh/m^2✓ = 1,796 m^2✓ (5)
[30]

QUESTION 3

3.1 3.1.1 (a) heights
(b) electrical

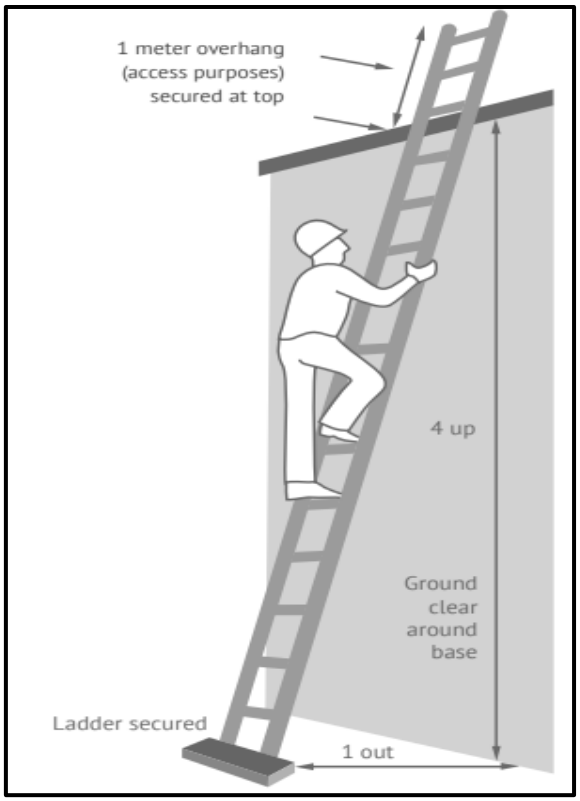
3.1.2 (c) lifting
(d) tanks

3.1.3 (e) heat
(f) fluid

(3 × 2) (6)

3.2 (i) Place the anchorage point at a right angle to the position of the line at the perimeter edge; a mobile anchorage is of assistance here.✓
(ii) Use secondary anchor points and/or anchor lines.✓
(iii) Use a perimeter guardrail to prevent any fall over the perimeter edge.✓ (3)

3.3



[Source: GIZ/S4GJ]

Drawing 3✓✓✓ / Labelling 3✓✓✓ (6)
[15]

QUESTION 4

4.1 4.1.1 Tempering valves blend hot and cold water to deliver mixed water at a constant and maximum temperature of around 60 °C. These types of valves incorporate temperature-sensitive elements which expand.

4.1.2 A vacuum breaker is a regulating device that provides a free flow of air into a system in order to prevent a siphon action from taking place, or negative pressure from being created in the system.

4.1.3 Non-return valves prevent reverse thermosiphon circulation, for example during low ambient temperatures at night from the tank (hot water) back to the collector (cold water). Thus, these types of valves allow the fluid to flow only in one direction.

(3 × 2) (6)

4.2 4.2.1 Heat loss due to defective or improperly installed check valve
4.2.2 Valve closed
4.2.3 Open valve
4.2.4 Valve closed
4.2.5 Open valve

(5 × 1) (5)

4.3 Most passive systems are designed as direct (open-loop) applications where water is the circulating fluid.✓ This simply means that cold water flows directly from the tank down to the collector.✓ In the collector, the water is heated by solar radiation✓ and circulates back to the tank due to the previously mentioned cold-hot-fluid cycle.✓ (Accept any relevant answers 4 × 1) (4)

4.4 **Advantages:**
Direct systems are the simplest and least expensive active-system type.✓ They do not use a heat exchanger✓ and transfer heat directly to the water.✓ Usually, the systems operate at standard line pressure and integrate easily with existing systems.✓ The pump can be powered by a PV panel and a battery backup, which makes these systems independent from the national grid.✓ (Accept any relevant answers 2 × 1)

Disadvantages:
Direct systems are not appropriate if the water is too hard,✓ because scale and corrosion could quickly disable the system.✓ They should never be installed in climates that experience freezing temperatures for sustained periods of time.✓ Indirect (Closed-Loop) System.✓
(Accept any relevant answers 2 × 1)
(2 + 2) (4)

4.5 (a) Water-pump pliers✓ (1)

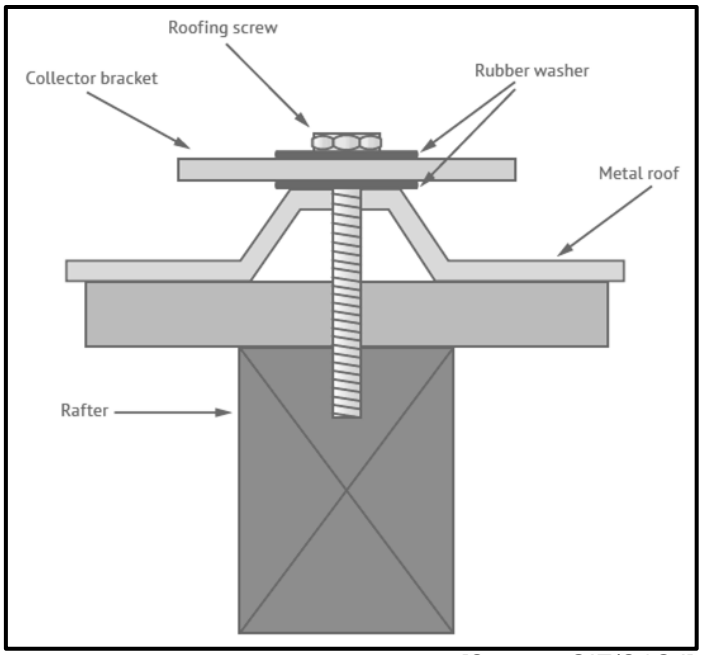
(b) Copper-pipe cutter✓ (1)

(c) Pipe wrench✓ (1)

4.6 1. Measure the required length of copper pipe.✓
2. Cut the copper pipe to size.✓
3. Ream/Debur the copper pipe and clean the inside of the copper fitting.✓
4. Apply flux to the pipe and fitting.✓
5. Assemble the connection.✓
6. Heat the connection with a gas torch.✓
7. Apply solder to the heated joint.✓
8. Allow the connection to cool and clean thoroughly.✓ (8)

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4.7



[Source: GIZ/S4GJ]

Drawing 2✓✓ / Labelling 3✓✓✓ (5)

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TOTAL: 100

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